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CLMSPTO

1. A method for using a processing device to pad data in a macroblock of a video object plane, said macroblock including both texture data and shape data, comprising the steps of:

(a) providing a first instruction for padding successive data elements of the texture data in a first direction within the macroblock, by selectively copying data from a preceding data element to a current data element of the macroblock in the first direction, as a function of the shape data corresponding to the current data element;

(b) providing a second instruction for padding successive data elements of the texture data in a second direction within the macroblock, opposite the first direction, by selectively copying data from a preceding data element to a current data element of the macroblock in the second direction as a function of the shape data corresponding to the current data element;

(c) processing the data elements of the texture data with:

(i) the first instruction;

(ii) then with the second instruction, producing first padded texture data;

(iii) then again with the first instruction, producing second padded texture data; and

(iv) averaging corresponding data elements of the first padded texture data and the second padded texture data, producing partially padded texture data; and

(d) padding any data elements of the partially padded texture data that are not yet padded, in a third direction in the macroblock, as a function of the partially padded texture data and of the shape data.

2. The method of Claim 1, wherein the third direction is orthogonal to the first and the second directions, and wherein the step of padding the data elements of the partially padded texture data that are not yet padded comprises the steps of:

(a) determining for each successive set of data elements that extend in the first and the second directions within the partially padded texture data, whether all of the data elements in the set have been provided with a texture value; and

(b) for each set of data elements in which none of the data elements have yet been provided with texture values:

(i) if, in regard to the third direction, any such set of data elements is disposed between two other sets of data elements that include texture data or padded data in the partially padded texture data, then padding each data element of said set with an average of the texture data from a corresponding data element of each of said two other sets, and otherwise;

(ii) padding each data element of the set of data elements with data from a corresponding data element in an adjacent set of data elements that includes texture data or padded data in the partially padded texture data.

3. The method of Claim 1, further comprising the step of temporarily storing texture data from a data element after padding in one of the first direction and the second direction, for use in padding in the other of the first direction and the second direction.

4. The method of Claim 1, wherein the step of padding any of the data elements of the partially padded texture data that are not yet padded comprises the steps of:

(a) transforming the partially padded texture data to produce transformed partially padded texture data in which the third direction is aligned with the first and second directions, as a result of the transformation; and

(b) repeating step (c) of Claim (1) on the transformed partially padded texture data.

5. The method of Claim 1, further comprising the step of only processing sets of data elements in the texture data in step (c) that require padding.

6. The method of Claim 5, further comprising the step of performing a logical AND of the shape data, along one of the first and second directions, to detect a logical state of a set of data elements in the shape data extending along said one of the directions, said logical state indicating whether a corresponding set of data elements in the texture data require padding.

7. The method of Claim 5, further comprising the step of performing a logical AND of the shape data, along the third direction, to detect a logical state of a set of data elements in the shape data extending along said third direction, said logical state indicating whether a corresponding set of data elements in the partially padded texture data require padding.

8. The method of Claim 1, wherein the first and the second instructions each have a latency of only one processing clock cycle.

9. The method of Claim 1, wherein the first and second directions extend along rows of the data elements in the texture data, and the third direction extends along columns of the data elements in the texture data.

10. A method for padding data of a macroblock in a video object plane, said macroblock including texture data and shape data, comprising the steps of:

(a) defining a first processor instruction that pads successive data elements of the texture data in a first direction along rows of the macroblock, by selectively copying data from a preceding data element in a row to a current data element in the row of the macroblock;

(b) defining a second processor instruction that pads successive data elements of the texture data in a second direction, opposite the first direction, along rows of the macroblock, by selectively copying data from a preceding data element in a row to a current data element in the row of the macroblock, along the second direction;

(c) applying the first and second processor instructions to the texture data in sequence, to pad data elements of each row of the texture data that do not include texture data, producing a partially padded macroblock;

(d) as a function of the shape data, determining each data element in the texture data of the partially padded macroblock that are yet to be padded; and

(e) padding each data element determined in the preceding step to produce a fully padded macroblock, using data from data elements in a column of the partially padded macroblock in which the data element that is being padded is disposed.

11. The method of Claim 10, wherein the step of padding each data element comprises the steps of:

(a) if the data element being padded is not disposed in the same column between two data elements that both include texture data, copying texture data from an adjacent data element in the same column into the data element being padded; and otherwise,

(b) padding the data element that is disposed in the same column between the two data elements with an average of the data of said two data elements.

12. The method of Claim 10, wherein the step of applying the first and second processor instructions to the texture data in sequence comprises the steps of:

(a) applying the first processor instruction to the texture data, producing texture data padded in the first direction;

(b) applying the second processor instruction to the texture data padded in the first direction, to produce first partially padded texture data;

(c) applying the first processor instruction to the first partially padded texture data, producing second partially padded texture data; and

(d) averaging the first partially padded texture data and the second partially padded texture data, producing the partially padded texture data.

13. The method of Claim 10, wherein the step of padding each data element comprises the steps of:

(a) applying a transformation to the partially padded texture data, producing transformed partially padded texture data in which columns of the partially padded texture data are transformed to rows of the transformed partially padded texture data;

(b) applying the first processor instruction to rows of the partially padded texture data, producing transformed partially padded texture data padded in the first direction;

(c) applying the second processor instruction to the rows of the transformed partially padded texture data that is padded in the first direction, to produce first transformed partially padded texture data;

(d) applying the first processor instruction to the rows of the first transformed partially padded texture data, producing second transformed partially padded texture data; and

(e) averaging the first transformed partially padded texture data with the second transformed partially padded texture data to produce the fully padded texture data.

14. The method of Claim 10, further comprising the step of temporarily storing data for a texture element disposed at an end of a row, as each of the first and second processor instructions are applied in sequence to rows of the texture data.

15. The method of Claim 10, further comprising the steps of:

(a) identifying, as a function of the shape data, specific rows of the texture data in which data elements are disposed that must be padded using data from adjacent data elements in the same column; and

(b) only padding the data elements in the specific rows of the texture data identified in the preceding step.

16. The method of Claim 15, wherein the step of identifying comprises the steps of:

(a) applying a logical OR function to successive rows of the shape data to produce a result for each row, said result indicating an empty row if the result for a row equals a binary zero; and

(b) only padding data elements of a row in which the result was not equal to a binary zero.

17. The method of Claim 15, wherein the step of identifying comprises the steps of:

(a) applying a logical AND function to successive rows of the shape data to produce a result for each row, said result indicating a corresponding row of the texture data that is full of data if the result for the row of the shape data equals a binary one; and

(b) only padding texture data for a row in which the result for the corresponding row of the shape data was not equal to a binary one, since padding of a row of texture data is not required if all data elements of the shape data for the corresponding row are equal to a binary one.

18. The method of Claim 10, wherein an arithmetic logic unit (ALU) employed to execute the first and second instructions to carryout steps (c)-(e), said ALU having a data capacity that is less than that of a row of the macroblock.

19. A system for padding data in a macroblock of a video object plane, said macroblock including texture data and shape data, comprising:

(a) a processing device coupled to receive a video data stream conveying the macroblock;

(b) a memory coupled to the processing device, said memory including machine instructions used for processing the macroblock when implemented by the processing device, said machine instructions including:

(i) a first processor instruction for padding successive data elements of the texture data in a first direction along rows of the macroblock, by selectively copying data from a preceding data element in a row to a current data element in the row of the macroblock, along the first direction; and

(ii) a second processor instruction for padding successive data elements of the texture data in a second direction, opposite the first direction, along rows of the macroblock, by selectively copying data from a preceding data element in a row to a current data element in the row of the macroblock, along the second direction; and

(c) said processing device responding to the machine instructions to apply the first instruction and second instruction in sequence to rows of the texture data, producing a first set of padded data and a second set of padded data, determining an average of corresponding data elements disposed in the first and second sets of padded data, producing partially padded texture data, and then padding columns of the partially padded texture data as a function of the shape data, to produce fully padded texture data.

20. The system of Claim 19, wherein the machine instructions cause the processing device to determine if a data element in the partially padded texture data does not include data, and if so, pads the data element using data from at least one adjacent data element in a column in which the data element being padded is disposed.

21. The system of Claim 20, wherein if the data element being padded is disposed between two data elements in the same column of the partially padded texture data and the two data elements both include data, the machine instructions cause the processing device to determine an average of the data for said two data elements to pad the data element being padded; and otherwise, the machine instructions cause the processing device to copy data from an adjacent data element in the same column as the data element being padded, for use in padding the data element being padded.

22. The system of Claim 19, wherein the processing device comprises an arithmetic logic unit.

23. The system of Claim 19, wherein the machine instructions further cause the processing device to temporarily store data from data elements at an end of the rows of the texture data, as the first and second instructions are sequentially applied to the rows.

24. The system of Claim 19, wherein the machine instructions further cause the processing device to apply a logical OR function to the shape data, to determine a result for each row of the shape data, and based upon the result for the row, to determine whether a corresponding row of the partially padded texture data needs to be padded using the data from at least one adjacent data element of the partially padded texture data.

25. The system of Claim 19, wherein the machine instructions further cause the processing device to apply a logical AND function to the shape data, to determine a result for each row of the shape data, and based upon the result for the row, to indicate whether a corresponding row of the texture data needs to be padded.

26. The system of Claim 19, wherein the first and the second processor instructions each have a latency of only one clock cycle of the processing device.

27. The system of Claim 19, wherein the processing device uses a multiplexer when implementing the first and second processor instructions.

Claims 28-31 are cancelled